Voice Coil PIFOC Focus Drive for Objectives

High-dynamics positioner for microscope objectives

V-308

- Adjustable travel range limitation to a total of 1 to 7 mm
- High dynamics direct drive
- Integrated weight force compensation to 1 kg, can be adjusted by the user
- Minimum incremental motion 10 nm
- Heavy-duty crossed roller guide
- Suitable optional accessories, e.g. objective holders

Z positioning of objectives with PIFOC
A positioning of the sample in the Z direction, i.e. along the optical axis of the objective, is required in many examinations or for microscopy technologies. Alternatively, it is possible to move the objective itself in the Z direction. For this purpose, PI offers solutions named PIFOC.

Integrated weight force compensation
The product is equipped with a magnetic weight force compensation. This maintains the position of a load of up to 1 kg aligned vertically to the motion axis even if no power is applied. The weight force compensation can be adjusted by the user.

PIMag® voice coil motor
Voice coil motors are direct drives. In direct drives, the force of the drive element is transmitted directly to the load to be moved without the use of mechanical transmission elements such as coupling, drive screw, or gearhead. Voice coil drives consist of a permanent magnet and a winding body that are located in the air gap of the magnetic field. When current flows through the winding body, it moves in the magnetic field of the permanent magnet. Thanks to their low weight and friction-free drive principle, voice coil drives are particularly suitable for applications that require high dynamics and high velocities at limited travel ranges. High scan frequencies and precision positioning are also possible with these drives, because they are free of the effects of hysteresis.

Crossed roller guide
With crossed roller guides, the point contact of the balls in ball guides is replaced by line contact of the hardened rollers. Consequently, they are considerably stiffer and need less preload, which reduces friction and allows smoother running. Crossed roller guides are also distinguished by high guiding accuracy and load capacity. Force-guided rolling element cages prevent cage creep.

Direct position measuring
Position measuring is performed with the highest accuracy directly at the motion platform so that nonlinearity, mechanical play, or elastic deformation have no influence on position measuring.

Application fields
Microscopy: Multiphoton fluorescence microscopy, deep tissue inspection, digital slide scanning microscopy. Biotechnology: Genome sequencing with the Solexa-Illumina method, Immuno-Assay fluorescence. Medical devices: Scanning laser ophthalmology, automated cell counters/flow cytometers. Biomedical research: Optical & magnetic tweezers. Laser materials processing: Laser micromachining, laser ablation. Semiconductor industry: Semiconductor/wafer inspection.

Motion	Unit	Tolerance	V-308.753030
Active axes			Z
Travel range in Z	mm		7
Acceleration in Z, unloaded	m/s²	Max.	8
Maximum velocity in Z, unloaded	mm/s		200
Straightness error E_XZ	µm	Max.	±0.75
Straightness error E_YZ	µm	Max.	±0.75
Angular error E_AZ	µrad	Max.	±50
Angular error E_BZ	µrad	Max.	±50
Angular error E_CZ	µrad	Max.	±50

Positioning	Unit	Tolerance	V-308.753030
Minimum incremental motion in Z	µm	Typ.	0.01
Positioning accuracy in Z, calibrated	µm	Typ.	±0.6
Positioning accuracy in Z, uncalibrated	µm	Typ.	±4
Bidirectional repeatability in Z	µm	Typ.	1
Bidirectional repeatability in Z, 100 nm step	nm		50
Reference switch			Optical, direction sensing (reference edge track), 5 V, TTL
Reference switch repeatability	µm		0.5
Integrated sensor			PIOne: Incremental linear encoder
Sensor signal			Sin/cos, 1 V peak-peak
Sensor signal period	µm		2
System resolution in Z	nm		1
Sensor resolution	nm		1
Position noise in Z	nm	Max.	3
Settling time in Z (100 nm step, ± 15 nm error band)	ms		15
Settling time in Z (250 nm step, ± 15 nm error band)	ms		15

Drive Properties	Unit	Tolerance	V-308.753030
Drive type			Voice coil
Nominal voltage	V		48
Nominal current, RMS	A	Typ.	1.15
Peak current, RMS	A	Typ.	3.5
Drive force in positive direction of motion in Z	N	Typ.	4.2
Drive force in negative direction of motion in Z	N	Typ.	4.2
Peak force in positive direction of motion in Z	N		9.45
Peak force in negative direction of motion in Z	N		9.45
Force constant	N/A		2.7
Motor constant	N/√W	Typ.	1.37
Resistance phase-phase	Ω	Typ.	3.9
Inductance phase-phase	mH		0.85
Back EMF	V·s/m	Max.	2.7
Permissible maximum temperature for drive components	°C		50

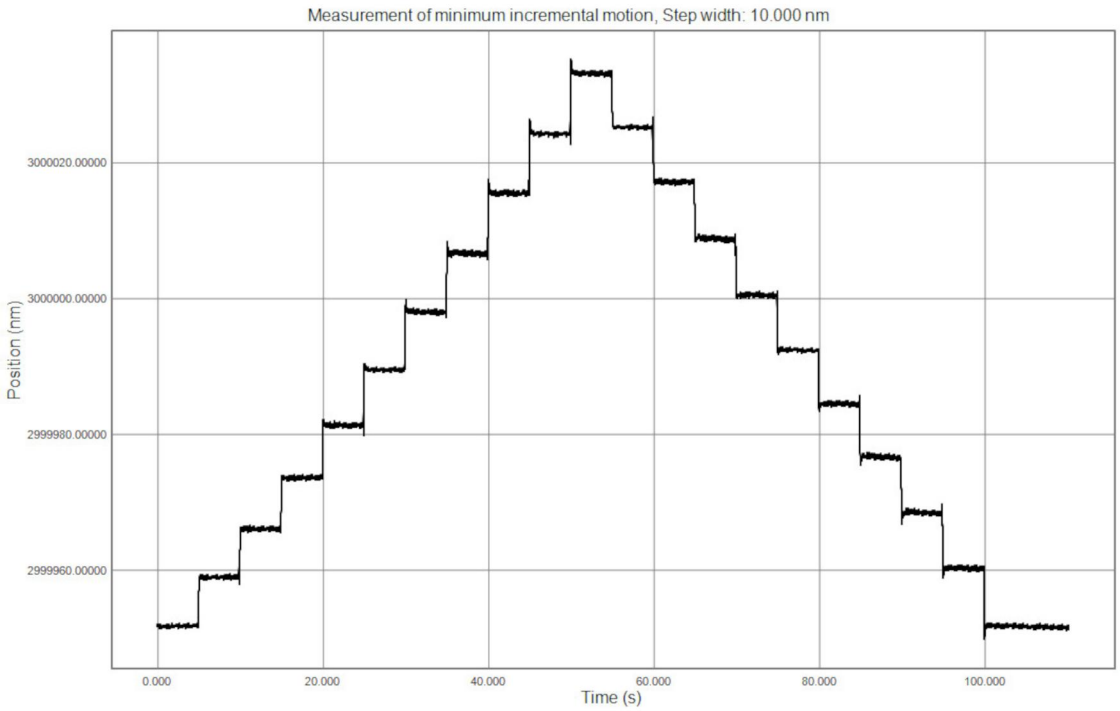
Mechanical Properties	Unit	Tolerance	V-308.753030
Permissible push force in X	N	Max.	10
Permissible push force in Y	N	Max.	10
Permissible push force in Z	N	Max.	10
Moved mass in Z, unloaded	g		200
Guide			Crossed roller guide
Overall mass	g		600
Mass without cable	g		450
Material			Aluminum, anodized

Miscellaneous	Unit		V-308.753030
Operating temperature range	°C		10 to 50
Connector			HD D-sub 26 (m)
Cable length	m		1.5
Recommended controllers / drivers			C-414, G-910, ACS SPiiPlus + NPMpm (NanoPWM incl.)

Note on sensor resolution and minimum incremental motion: With C-414 motion controller at an interpolation of 2^{11}
Note on settling time: With gain scheduling (only with NanoPWM)
Note on positioning accuracy and repeatability: Following ISO 230-2
Note on nominal current, peak current: Max. 10 s at 70 °C coil temperature
Note on nominal current, RMS: Value without cooling; with cooling: 1.55 A; with horizontally aligned positioner, with perforated plate made of steel, 200 mm × 250 mm × 12 mm
Note on inductance: Value at 100 mHz

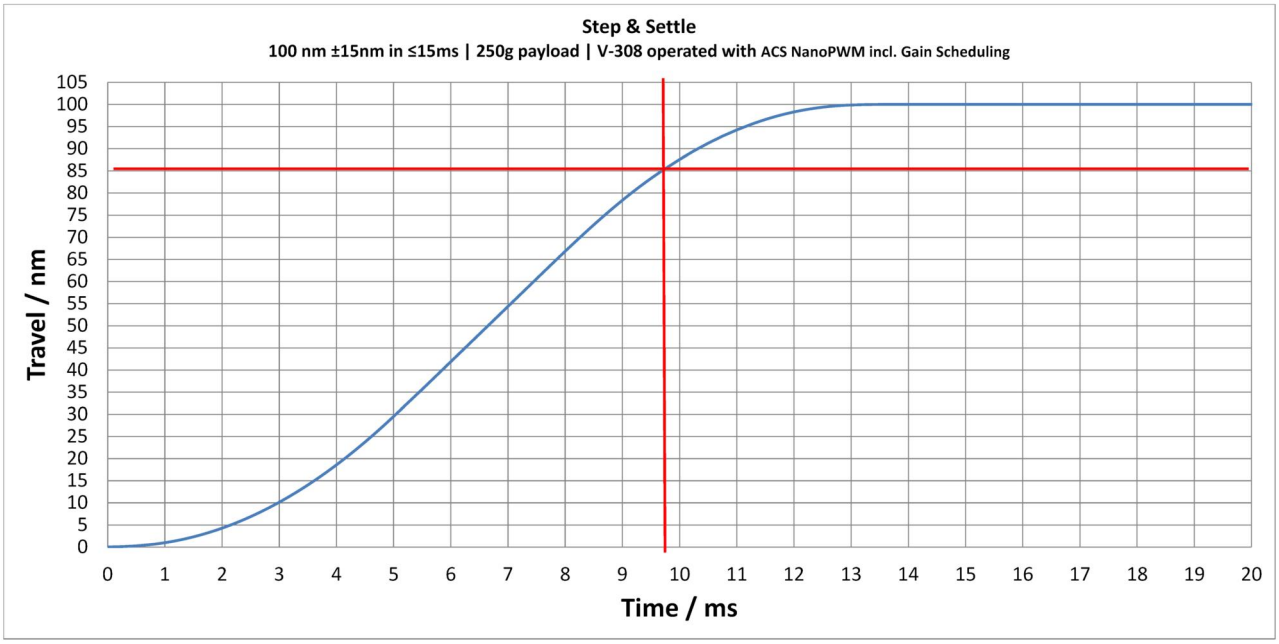
At PI, technical data is specified at 22 ±3 °C. Unless otherwise stated, the values are for unloaded conditions. Some properties are interdependent. The designation "typ." indicates a statistical average for a property; it does not indicate a guaranteed value for every product supplied. During the final inspection of a product, only selected properties are analyzed, not all. Please note that some product characteristics may deteriorate with increasing operating time.

Drawings / Images



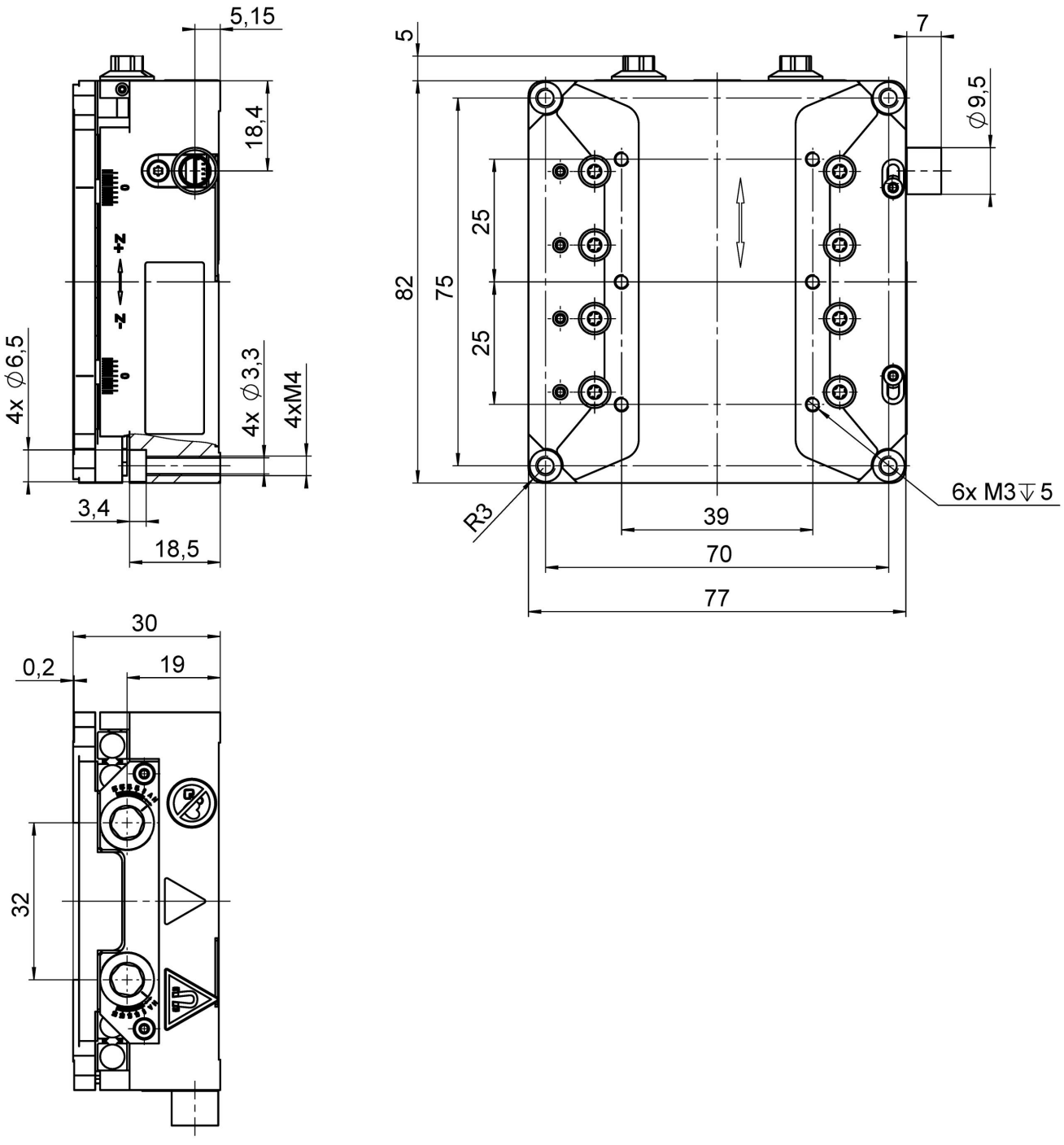
V-308.753030: Measurement for proving the minimum incremental motion of 10 nm

Drawings / Images



V-308 settling time with 250 g load at a step of 100 nm in an error band of +/-15 nm

Drawings / Images



V-308.753030, dimensions in mm

Drawings / Images

V-308 with V-308.AP1 adapter plate, V-308.OH1 objective holder, P-725.11L thread adapter, and objective

Order Information

V-308.753030
Voice coil PIFOC focus drive for objectives; voice coil; 7 mm travel range; 10 N load capacity; 200 mm/s max. velocity; PIOne: incremental linear encoder, 2 µm sensor signal period, sin/cos, 1 V peak-peak; 1.5 m cable length

PIFOC Scanner System for Microscope Objectives

Dynamic focus scanner of the entry-level class for travel ranges up to 400 µm, incl. controller

P-725.xCDE1S

- Travel range 100 µm or 400 µm
- Significantly faster response and longer lifetime than motorized drives
- Fine positioning of objectives with sub-nm resolution
- Large clear aperture with Ø 29 mm

Application fields

- Super-resolution microscopy
- Light disk microscopy
- Confocal microscopy
- 2-photon microscopy
- 3D imaging
- Screening
- Interferometry
- Measuring technology
- Autofocus systems
- Biotechnology
- Semiconductor inspection

PIFOC scanner system of the entry-level class

System consisting of P-725.xCDE1 PIFOC scanner and E-709.1C1L controller.

Outstanding lifetime thanks to PICMA® piezo actuators

PICMA® piezo actuators are all-ceramic insulated. This protects them against humidity and failure resulting from an increase in leakage current. PICMA® actuators offer an up to ten times longer lifetime than conventional polymer-insulated actuators. 100 billion cycles without a single failure are proven.

Subnanometer resolution with capacitive sensors

Capacitive sensors measure with subnanometer resolution without contacting. They guarantee excellent linearity of motion, long-term stability, and a bandwidth in the kHz range.

High guide accuracy due to zero-play flexure guides

Flexure guides are free of maintenance, friction, and wear, and do not require lubrication. Their stiffness allows high load capacity and they are insensitive to shock and vibration. They work in a wide temperature range.

Motion	Unit	Tolerance	P-725.1CDE1S	P-725.4CDE1S
Active axes			Z	Z
Travel range in Z	µm	+20 % / -0 %	100	400
Travel range in Z, open loop	µm	±20 %	120	420
Linearity error in Z	%	Max.	0.2	0.2

Positioning	Unit	Tolerance	P-725.1CDE1S	P-725.4CDE1S
Minimum incremental motion in Z	nm		2	4
Point repeatabilitiy, 10 % step, 1 sigma	nm	Max.	20	20
Integrated sensor			Capacitive, direct position measuring	Capacitive, direct position measuring
Sensor noise, 1 sigma	nm	Max.	5	5

Drive Properties	Unit	Tolerance	P-725.1CDE1S	P-725.4CDE1S
Drive type			PICMA®	PICMA®
Electrical capacitance in Z	µF	±20 %	3.2	6.2

Mechanical Properties	Unit	Tolerance	P-725.1CDE1S	P-725.4CDE1S
Stiffness in Z	N/µm	Min.	0.23	0.12
Resonant frequency in Z, unloaded	Hz	Min.	470	230
Resonant frequency in Z, under load with 150 g	Hz	Min.	185	120
Permissible push force in Z	N	Max.	100	100
Permissible pull force in Z	N	Max.	20	20
Guide			Flexure guide with lever amplification	Flexure guide with lever amplification
Overall mass	g	±5 %	280	280
Material			Stainless steel, aluminum	Stainless steel, aluminum
Objective diameter	mm	Max.	39	39

Miscellaneous	Unit	Tolerance	P-725.1CDE1S	P-725.4CDE1S
Operating temperature range	°C		10 to 70	10 to 70
Connector			D-sub 7W2 (m)	D-sub 7W2 (m)
Cable length	m	+50 mm / -0 mm	1.5	1.5

Controller	Unit	Tolerance	P-725.1CDE1S	P-725.4CDE1S
Controller type			E-709.1C1L	E-709.1C1L
Application-related functions			Data recorder	Data recorder
Communication interfaces			RS-232 | SPI | USB	RS-232 | SPI | USB
Command set			GCS 2.0	GCS 2.0
User software			PIMikroMove	PIMikroMove
Software drivers			GCS DLL (with code examples for the most common programming languages such as C++, C#, VB.NET, Python, Delphi), driver for NI LabVIEW, MATLAB library	GCS DLL (with code examples for the most common programming languages such as C++, C#, VB.NET, Python, Delphi), driver for NI LabVIEW, MATLAB library
I/O lines			4 digital inputs, 4 digital outputs, 1 servo cycle output, 1 reset input (each TTL). I/O for external synchronization of the servo cycle (100 kHz). RxD and TxD for RS-485.	4 digital inputs, 4 digital outputs, 1 servo cycle output, 1 reset input (each TTL). I/O for external synchronization of the servo cycle (100 kHz). RxD and TxD for RS-485.
Controller's dimensions			160 mm × 104 mm × 44 mm	160 mm × 104 mm × 44 mm

Linearity error: The specified value can only be reached with recommended digital controllers.
Position noise: 1 sigma
The objective is not included in the scope of delivery.

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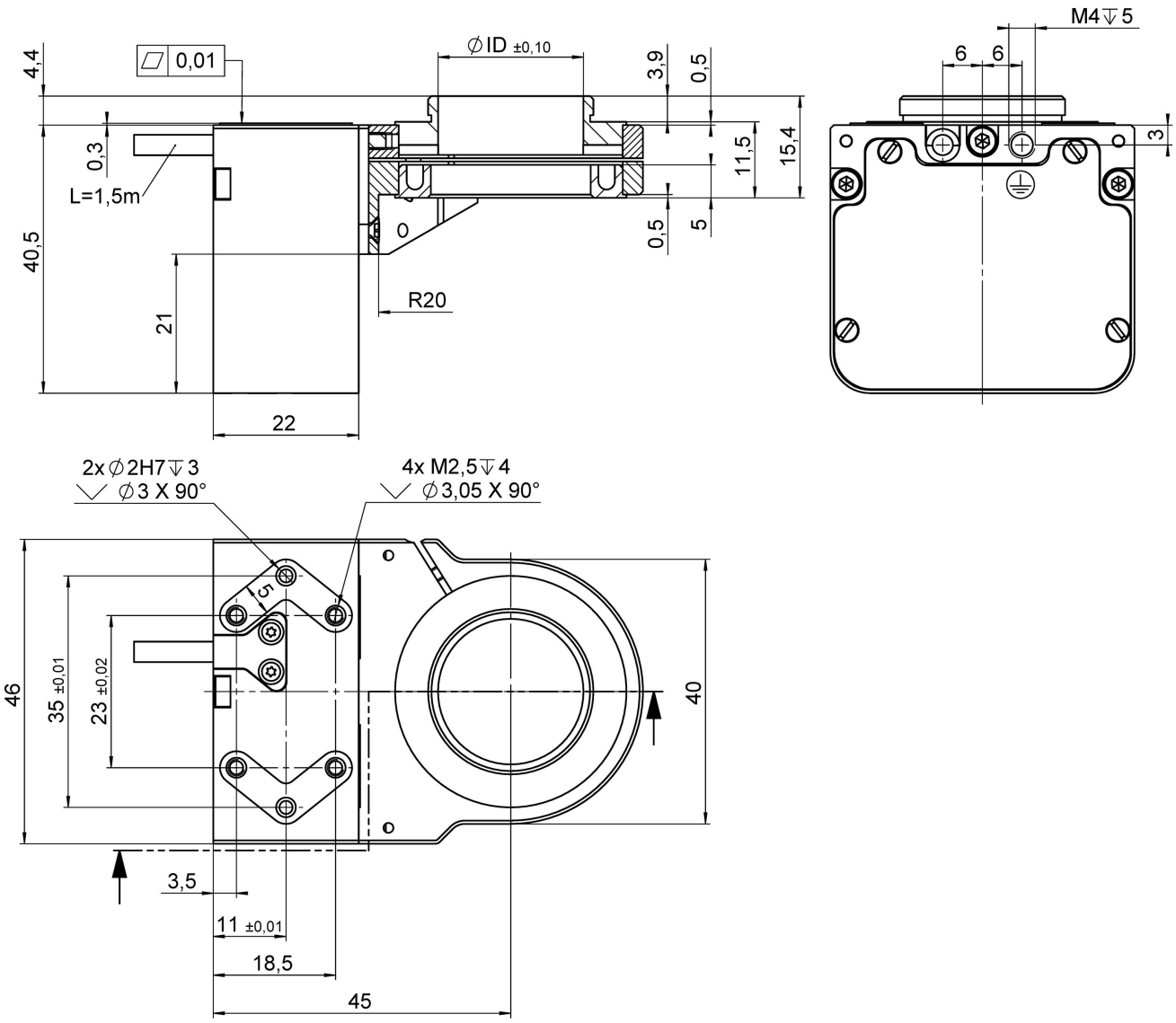
Drawings / Images

Thread	Microscope Side Thread Adapter		Objective / Lens Side Thread Adapter	Objective Spacer for Correcting the Parfocal Length
	P-725.**xxM**	ID in mm	P-725.**xxL**	P-725.**xxS**
M26 x 0.75	P-725.02M	22	P-725.02L	P-725.02S
M27 x 0.75	P-725.03M	22	P-725.03L	P-725.03S
M28 x 0.75	P-725.04M	22	P-725.04L	P-725.04S
M32 x 0.75	P-725.05M	25	P-725.05L	P-725.05S
M26 x 1/36"	P-725.06M	22	P-725.06L	P-725.06S
M19 x 0.75	P-725.08M	15	P-725.08L	P-725.08S
M25 x 0.75	P-725.11M	22	P-725.11L	P-725.11S
W0.8 x 1/36"	P-725.12M	16	P-725.12L	P-725.12S
SM1 (1.035"-40)	P-725.13M	22	P-725.13L	P-725.13S
M34 x 1	P-725.14M	28	P-725.14L	P-725.14S

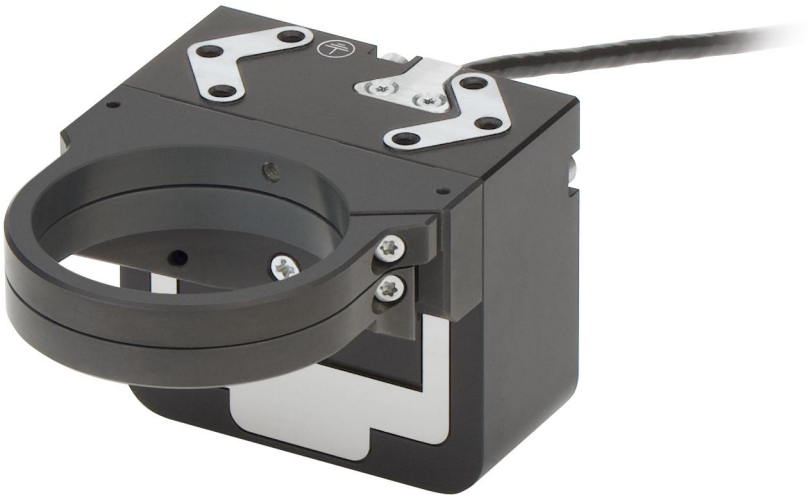
Threaded adapter and spacers for P-725.xCDEx and P-725.xCDE1S

Drawings / Images



P-725.1CDE2 and P-725.4CDE2, dimensions in mm (please order the adapter and spacers separately). Note that a comma is used in the drawings instead of a decimal point.

Drawings / Images



P-725.1CDE1 / P-725.4CDE1

P-725.8CDE2 with P-725.03x thread adapters and P-725.03S spacer inserted between the microscope turret and the objective

Order Information

P-725.1CDE1S
PIFOC scanner system for microscope objectives; fast step-and-settle; 100 µm travel range; capacitive, direct position measuring; D-sub 7W2 (m) connector; 1.5 m cable length. System consisting of P-725.1CDE1 PIFOC scanner and E-709.1C1L controller.

P-725.4CDE1S
PIFOC scanner system for microscope objectives; fast step-and-settle; 400 µm travel range; capacitive, direct position measuring; D-sub 7W2 (m) connector; 1.5 m cable length. System consisting of P-725.4CDE1 PIFOC scanner and E-709.1C1L controller.

PIFOC Focus Scanner for Microscope Objectives

Dynamic Scanning with Travel Ranges of 100 µm, 400 µm, or 800 µm

P-725.xCDE2

- Travel range 100 µm, 400 µm, or 800 µm
- Significantly faster response and longer lifetime than motorized drives
- Fine positioning of objectives with sub-nm resolution
- Direct position measuring with capacitive sensors: Highest linearity
- Large clear aperture with Ø 29 mm

Application fields

- Super-resolution microscopy
- Light disk microscopy
- Confocal microscopy
- 2-photon microscopy
- 3D imaging
- Screening
- Interferometry
- Measuring technology
- Autofocus systems
- Biotechnology
- Semiconductor inspection

Outstanding lifetime due to PICMA® piezo actuators

The PICMA® piezo actuators are all-ceramic insulated. This protects them against humidity and failure resulting from an increase in leakage current. PICMA® actuators offer an up to ten times longer lifetime than conventional polymer-insulated actuators. 100 billion cycles without a single failure are proven.

Subnanometer resolution with capacitive sensors

Capacitive sensors measure with subnanometer resolution without contacting. They guarantee excellent linearity of motion, long-term stability, and a bandwidth in the kHz range.

High guiding accuracy due to zero-play flexure guides

Flexure guides are free of maintenance, friction, and wear, and do not require lubrication. Their stiffness allows high load capacity and they are insensitive to shock and vibration. They work in a wide temperature range.

Motion	Unit	Tolerance	P-725.1CDE2	P-725.4CDE2	P-725.8CDE2
Active axes			Z	Z	Z
Travel range in Z	µm	+20 / -0 %	100	400	800
Travel range in Z, open loop	µm	±20%	120	420	840
Linearity error in Z	%		<0.03	<0.03	<0.03
Angular error around X	µrad		±10	±10	±50
Angular error around Y	µrad		±10	±45	±50

Positioning	Unit	Tolerance	P-725.1CDE2	P-725.4CDE2	P-725.8CDE2
Minimum incremental motion in Z	nm		1	4	5
Point repeatabilitiy, 10% step, 1 sigma	nm		10	10	50
Integrated sensor			Capacitive, direct position measuring	Capacitive, direct position measuring	Capacitive, direct position measuring
Sensor noise, 1 sigma	nm		0.2	0.2	0.8
Position noise in Z	nm	Max.	0.1	0.1	0.4
Settling time for 10% step in Z	ms	±10%	14	22	39

Drive Properties	Unit	Tolerance	P-725.1CDE2	P-725.4CDE2	P-725.8CDE2
Drive type			PICMA®	PICMA®	PICMA®
Electrical capacitance in Z	µF	±20%	3.2	6.4	12.8

Mechanical Properties	Unit	Tolerance	P-725.1CDE2	P-725.4CDE2	P-725.8CDE2
Stiffness in Z	N/µm	±20%	0.5	0.25	0.07
Resonant frequency in Z, unloaded	Hz	±20%	680	400	230
Resonant frequency in Z, under load with 150 g	Hz	±20%	290	175	110
Permissible push force in Z	N	Max.	100	100	100
Permissible pull force in Z	N	Max.	20	20	20
Guide			Flexure guide with lever amplification	Flexure guide with lever amplification	Flexure guide with lever amplification
Overall mass	g	±5%	280	280	350
Material			Stainless steel, aluminum	Stainless steel, aluminum	Stainless steel, aluminum
Objective diameter	mm	Max.	39	39	39

Miscellaneous	Unit	Tolerance	P-725.1CDE2	P-725.4CDE2	P-725.8CDE2
Operating temperature range	°C		10 to 70	10 to 70	10 to 70
Connector			D-sub 7W2 (m)	D-sub 7W2 (m)	D-sub 7W2 (m)
Cable length	m	+50 / -0 mm	1.5	1.5	1.5
Recommended controllers / drivers			E-709.1C1L - economic choice, suitable for most use cases; E-754.1CD - high performance choice for highest precision	E-709.1C1L - economic choice, suitable for most use cases; E-754.1CD - high performance choice for highest precision	E-709.1C1L - economic choice, suitable for most use cases; E-754.1CD - high performance choice for highest precision

Linearity error: Under laboratory conditions, a digital controller makes it possible to reduce the linearity error even further.
Settling time: 1% error band, 150 g load
Position noise: 1 sigma
The objective is not included in the scope of delivery.

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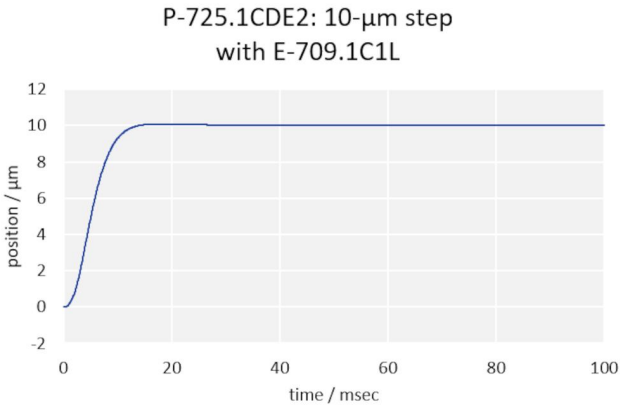
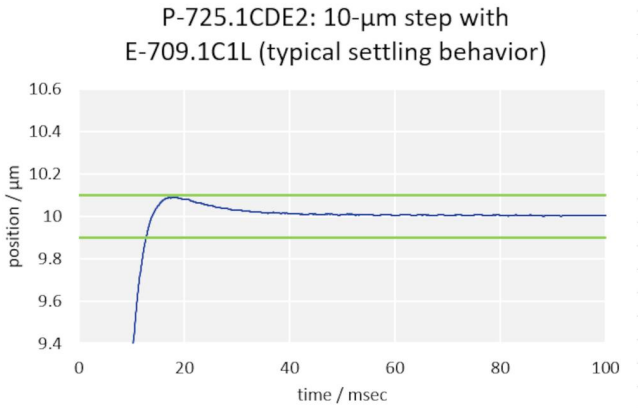
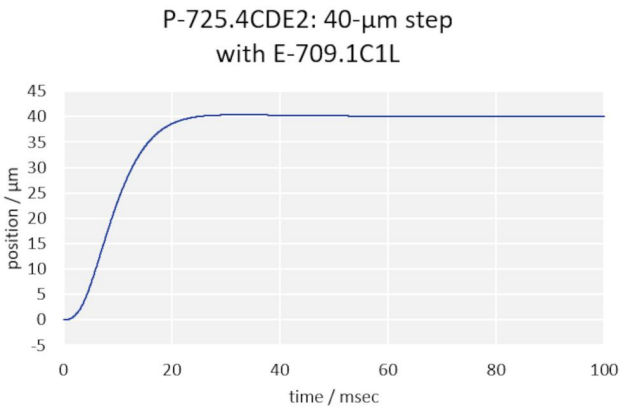
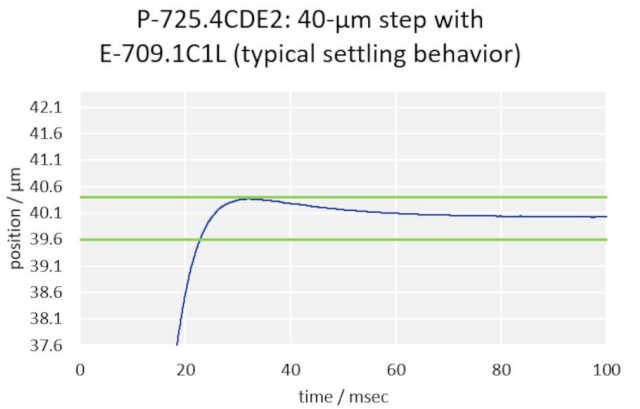
Drawings / Images



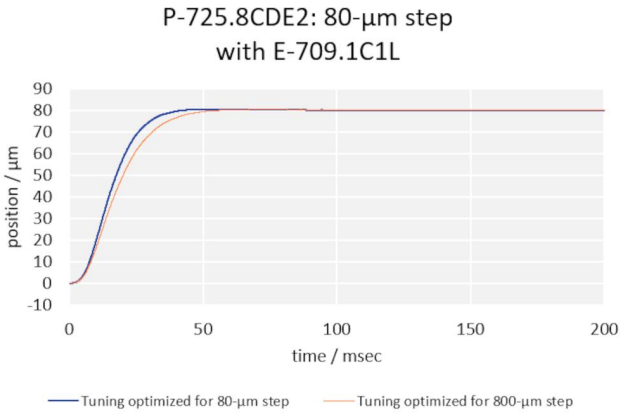


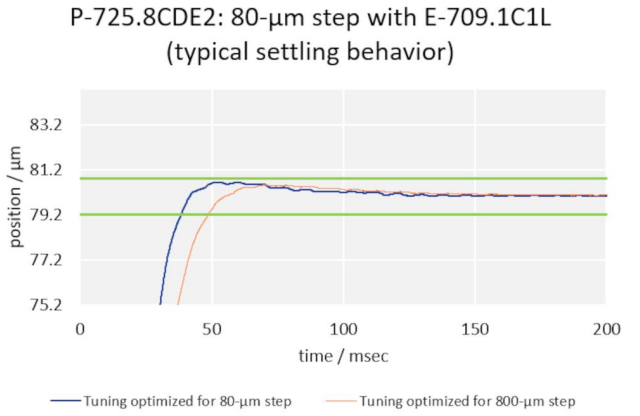
Fast step-and-settle: Due to its stiff design, the P-725.1CDE2 PIFOC can make a 10-µm step with an error band of 1% in only 14 ms (150 g load, with E-709.1C1L controller).





Fast step-and-settle: Due to its stiff design, the P-725.4CDE2 PIFOC can make a 40-µm step with an error band of 1% in only 22 ms (150 g load, with E-709.1C1L controller).





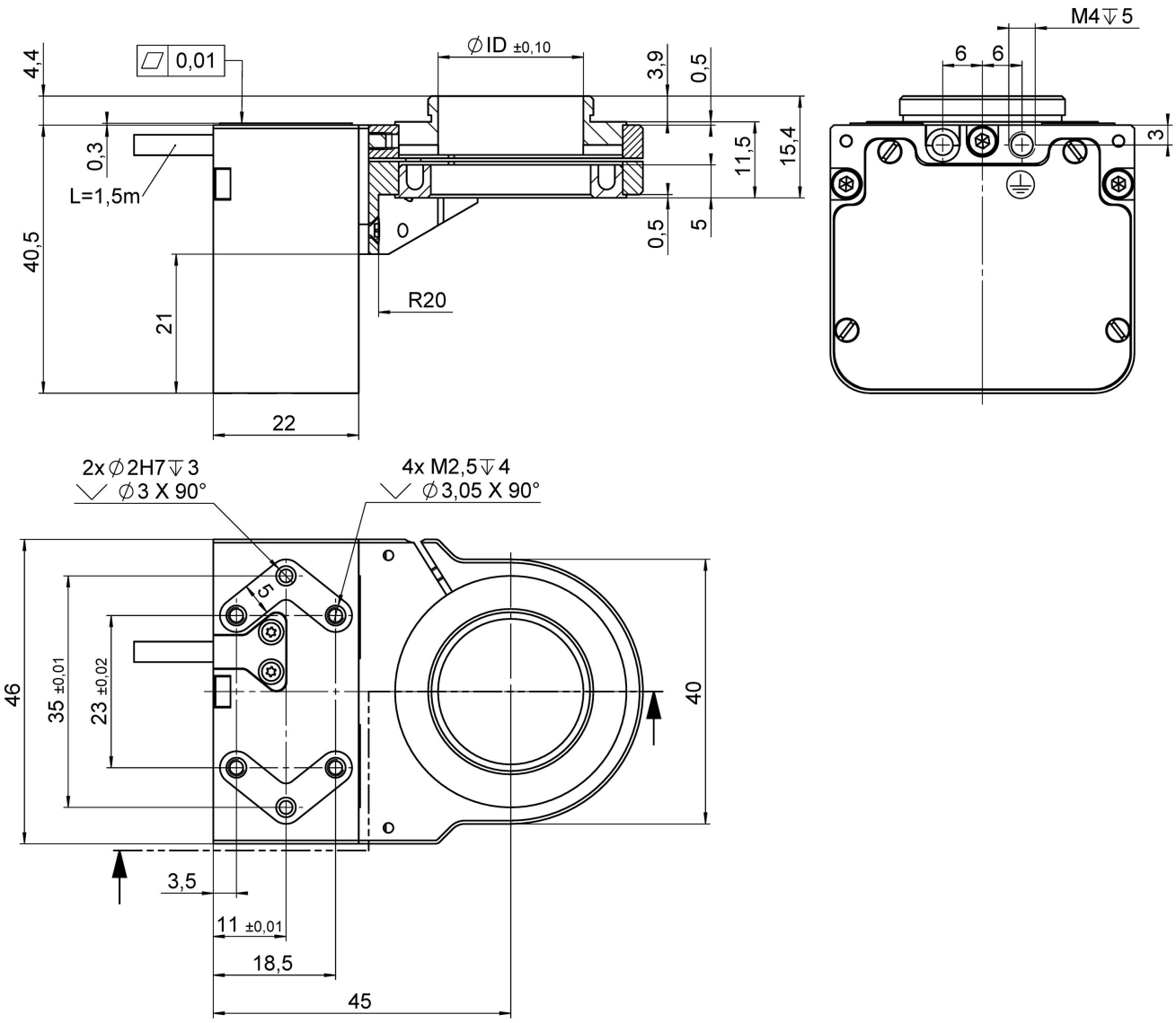
Fast step-and-settle: Due to its stiff design, the P-725.8CDE2 PIFOC can make a 80-µm step with an error band of 1% in only 39 ms (150 g load, with E-709.1C1L controller).

Drawings / Images

Thread	Microscope Side Thread Adapter		Objective / Lens Side Thread Adapter	Objective Spacer for Correcting the Parfocal Length
	P-725.**xxM**	ID in mm	P-725.**xxL**	P-725.**xxS**
M26 x 0.75	P-725.02M	22	P-725.02L	P-725.02S
M27 x 0.75	P-725.03M	22	P-725.03L	P-725.03S
M28 x 0.75	P-725.04M	22	P-725.04L	P-725.04S
M32 x 0.75	P-725.05M	25	P-725.05L	P-725.05S
M26 x 1/36"	P-725.06M	22	P-725.06L	P-725.06S
M19 x 0.75	P-725.08M	15	P-725.08L	P-725.08S
M25 x 0.75	P-725.11M	22	P-725.11L	P-725.11S
W0.8 x 1/36"	P-725.12M	16	P-725.12L	P-725.12S
SM1 (1.035"-40)	P-725.13M	22	P-725.13L	P-725.13S
M34 x 1	P-725.14M	28	P-725.14L	P-725.14S

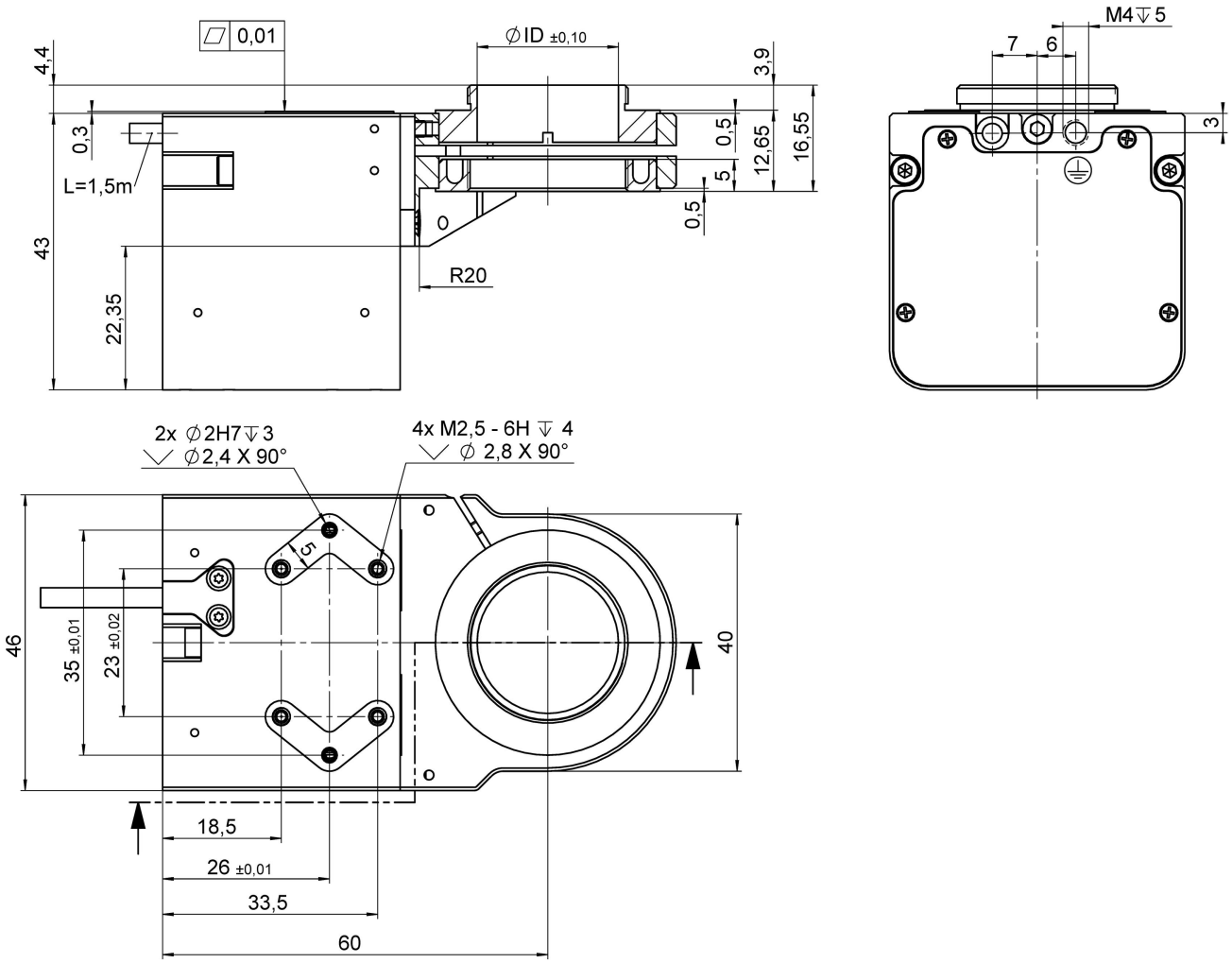
Threaded adapter and spacers for P-725.xCDEx and P-725.xCDE1S

Drawings / Images



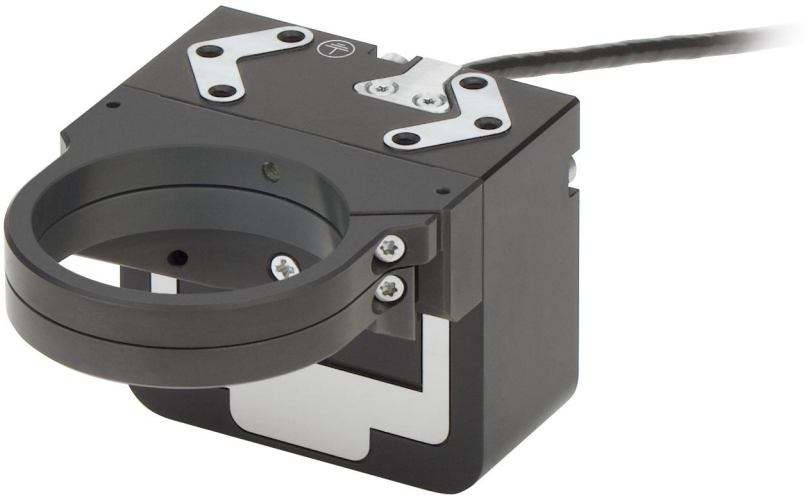
P-725.1CDE2 and P-725.4CDE2, dimensions in mm (please order the adapter and spacers separately). Note that a comma is used in the drawings instead of a decimal point.

Drawings / Images



P-725.8CDE2, dimensions in mm (please order the adapter and spacers separately). Note that a comma is used in the drawings instead of a decimal point.

Drawings / Images



P-725.4CDE2

P-725.8CDE2

Drawings / Images

P-725.8CDE2 with P-725.03x thread adapters and P-725.03S spacer inserted between the microscope turret and the objective

Order Information

P-725.1CDE2
PIFOC focus scanner for microscope objectives, high precision, fast step-and-settle, 100 µm, capacitive sensors, D-sub connector

P-725.4CDE2
PIFOC focus scanner for microscope objectives, high precision, fast step-and-settle, 400 µm, capacitive sensors, D-sub connector

P-725.8CDE2
PIFOC focus scanner for microscope objectives, high precision, fast step-and-settle, 800 µm, capacitive sensors, D-sub connector